Cooperative Effects In Optics Superradiance And Phase

In the 50 years since the first volume of Progress in Optics was published, optics has become one of the most dynamic fields of science. The volumes in this series that have appeared up to now contain more than 300 review articles by distinguished research workers, which have become permanent records for many important developments. Invariant Optical Fields Quantum Optics in Structured Media Polarization and Coherence Optics Optical Quantum Computation Photonic Crystals Lase Beam-Splitting Gratings

This unique monograph series "Progress in Nano-Electro Optics" reviews the results of advanced studies of electro-optics on the nanometric scale. This third volume covers the most recent topics of theoretical and experimental interest including classical and quantum optics, organic and inorganic material science and technology, surface science, spectroscopy, atom manipulation, photonics, and electronics. The first two volumes addressed the "Basics and Theory of Near Field Optics" (2002) and "Novel Devices and Atom Manipulation" (2003).

In last years increasing attention has been again devoted to interpretations of quantum theory. In the same time interesting quantum optical experiments have been performed using nonlinear optical processes, in particular frequency down conversion, which provided new information about nature of a photon on the basis of interference and correlation (coincidence) phenomena. Such single-photon and twin-photon effects of quantum optics provide new point of view of interpretations of quantum theory and new tests of its principles. The purpose of this book is to discuss these questions. To follow this goal we give brief reviews of principles of quantum theory and of quantum theory of measurement. As a fundamental theoretical tool the coherent state technique is adopted based on a general algebraic treatment, including the de scription of interaction of radiation and matter. Typical quantum behaviour of physical systems is exhibited by nonclassical optical phenomena, which can be examined using photon interferences and correlations. These phenomena are closely related to violation of various classical inequalities and Bell's in equalities. The most important part of this book discusses quantum optical experiments supporting quantum theory. This book may be considered as a continuation of previous monographs by one of the authors on Coherence of Light (Van Nostrand Reinhold, London 1972, second edition D. Reidel, Dordrecht 1985) and on Quantum Statistics of Linear and Nonlinear Optical Phenomena (D. Reidel, Dordrecht 1984, second edition Kluwer, Dordrecht 1991), which may serve as a preparation for reading this book.

The content of this volume has been added to the online reference work Encyclopedia of Magnetic Resonance. For further information see Encyclopedia of Magnetic Resonance. As a stand alone volume, Advances in NMR comprehensively highlights the rapid progress of nuclear magnetic resonance over the last five years. Features 66 articles on the latest major advances in NMR Written by over 80 internationally recognised experts With over 900 pages, illustrated extensively throughout, and an easy to read large double-columned format, Advances in NMR covers indepth articles on the latest advances in spectroscopic techniques; nuclear interactions; biochemical, physical and chemical applications. Including these outstanding articles: Double-Quantum NMR Spectroscopy of Dipolar Coupled Spins Under Fast Magic Angle Spinning (H W Spiess) Pulse Sequence Design using Rotor and Spin Symmetry (M Levitt) Indirect Nuclear Spin-Spin Coupling Tensors (R E Wasylishen) Weakly Aligned Biomolecules in Liquid Crystals (A Bax) Multiple-Resonance, Multi-dimensional Solid-state NMR of Proteins (S J Opella) Dynamics of Hydrogen Transfer in Liquids and Solids (H Limbach) Optically Pumped NMR of Semiconductors and Two-dimensional Electron Systems (R Tycko/S E Barrett) "The list of contributors looks like a Who's Who of the subject" —The Times Higher Education Supplement

The exciting field of nanostructured materials offers many challenging perspectives for fundamental research and technological applications. The combination of quantum mechanics, interaction, phase coherence, and magnetism are important for understanding many physical phenomena in these systems. This book provides an overview of many aspects of interacting electrons in nanostructures, including such interesting topics as quantum dots, quantum wires, molecular electronics, dephasing, spintronics, and nanomechanics. The content reflects the current research in this area and is written by leading experts in the field.

This volume brings together contributions from world renowned researchers on molecular nonlinear optics. It takes as its impetus work done over the last five years in which newly developed optoelectronic devices havedeepened our understanding of the fundamental physics and chemistry underlying these materials. Organic materials involving thin films, polymers, and resulting devices will be emphasized.

Cooperative Effects in Optics, Superradiance and Phase TransitionsCRC Press

Compiled by 330 of the most widely respected names in the electro-optical sciences, the Encyclopedia is destined to serve as the premiere guide in the field with nearly 2000 figures, 560 photographs, 260 tables, and 3800 equations. From astronomy to x-ray optics, this reference contains more than 230 vivid entries examining the most intriguing technological advances and perspectives from distinguished professionals around the globe. The contributors have selected topics of utmost importance in areas including digital image enhancement, biological modeling, biomedical spectroscopy, and ocean optics, providing thorough coverage of recent applications in this continually expanding field.

This thesis describes the first demonstration of a cooperative optical non-linearity based on Rydberg excitation. Whereas in conventional non-linear optics the non-linearity arises directly from the interaction between light and matter, in a cooperative process it is mediated by dipole-dipole interactions between light-induced excitations. For excitation to high Rydberg states where the electron is only weakly bound, the dipole-dipole interactions are extremely large and long range, enabling an enormous enhancement of the non-linear effect. Consequently, cooperative non-linear optics using Rydberg excitations opens a new era for quantum optics enabling large single photon non-linearity to be accessible in free space for the first time. The thesis describes the theoretical underpinnings of the non- linear effect, the pioneering experimental results and implications for experiments in the single photon regime.

SPIE Milestones are collections of seminal papers from the world literature covering important discoveries and developments in optics and photonics.

In the early 1970s, researchers in Canada, the Soviet Union and the United States discovered that powerful infrared laser pulses are capable of dissociating mole cules such as SiF4 and SF6' This result, which was so unexpected that for some time the phenomenon of multiple-photon dissociation was not recognized in many cir cumstances in which we now know that it occurs, was first publicized at a time when the possibility of using lasers for the separation of isotopes had attracted much attention in the scientific community. From the mid-1970s to the early 1980s, hun dreds of experimental papers were published describing the multiple-photon absorp tion of C02 laser pulses in nearly every simple molecule with an absorption band in the 9 - 11 jJm region. Despite this impressive volume of experimental results, and despite the efforts of numerous theorists, there is no agreement among re searchers in the field on many fundamental aspects of the absorption of infrared laser light by polyatomic molecules. This book is devoted to reviells of the experimental and theoretical research that provides the foundations for our current understanding of molecular multiple photon exc itat i on, and to rev i ews of research that is pert i nent to the 1 aser sep aration of isotopes.

This book presents a systematic account of optical coherence theory within the framework of classical optics, as applied to such topics as radiation from sources of different states of coherence, foundations of radiometry, effects of source coherence on the spectra of radiated

fields, coherence theory of laser modes, and scattering of partially coherent light by random media. The book starts with a full mathematical introduction to the subject area and each chapter concludes with a set of exercises. The authors are renowned scientists and have made substantial contributions to many of the topics treated in the book. Much of the book is based on courses given by them at universities, scientific meetings and laboratories throughout the world. This book will undoubtedly become an indispensable aid to scientists and engineers concerned with modern optics, as well as to teachers and graduate students of physics and engineering.

In studying the radiation-matter interaction, one can take two different approaches. The first is typical of spectroscopy: one considers the interaction between radi ation and a single atom, i. e. , one studies those phenomena in which the presence of other atoms is irrelevant. The other attitude consists, in contrast, in studying those phenomena which arise just from the simultaneous presence of many atoms. In fact, all the atoms interact with the same electromagnetic field; under suitable conditions, this situation creates strong atom-atom correlations, which in turn give rise to a cooperative behavior of the system as a whole. Cooperative means that the overall behavior is quite different from the superposition of the effects arising from single atoms and is completely unpredictable if one neglects the coup ling between the atoms induced by their common electromagnetic field. This book contains five complete and up-to-date contributions on the theory and experiments of three coherence effects in radiation-matter interaction: resonance fluorescences, optical bistability, and superfluorescence. They have raised in creasing interest in recent years from both a fundamental and an applicative view point. Even if their phenomenology appears completely different, these effects be long in the same book because they are striking examples of open systems driven far from thermal equilibrium, as those considered in Haken's synergetics and in Prigogine's theory of dissipative structures. This aspect is discussed in the in troducting chapter, in which we outline the basic physics and the essential features which unify these three effects.

Advances in Atomic, Molecular, and Optical Physics publishes reviews of recent developments in a field which is in a state of rapid growth, as new experimental and theoretical techniques are used on many old and new problems. Topics covered include related applied areas, such as atmospheric science, astrophysics, surface physics and laser physics. Articles are written by distinguished experts, and contain both relevant review material and detailed descriptions of important recent developments. International experts Comprehensive articles New developments

This thesis offers a comprehensive introduction to surface acoustic waves in the quantum regime. It addresses two of the most significant technological challenges in developing a scalable quantum information processor based on spins in quantum dots: (i) decoherence of the electronic spin qubit due to the surrounding nuclear spin bath, and (ii) long-range spin-spin coupling between remote qubits. Electron spins confined in quantum dots (QDs) are among the

leading contenders for implementing quantum information processing. To this end, the author pursues novel strategies that turn the unavoidable coupling to the solid-state environment (in particular, nuclear spins and phonons) into a valuable asset rather than a liability.

Written as a collection of problems, hints and solutions, this book should provide help in learning about both fundamental and applied aspects of this vast field of knowledge, where rapid and exciting developments are taking place.

Super-radiance: Multiatomic Coherent Emission provides a comprehensive, self-contained account of the theory and experiments of the quantum optic phenomenon of superradiance. Contributed by highly regarded researchers in the field, the book first presents the theory of superradiance at a level suitable for graduate physicists approaching the subject for the first time. This introduction is followed by a more rigorous treatment that is supported by the analysis of experiments dealing with superradiance and by a discussion on the possible uses of the effect in other areas of optics and electronics. The theoretical and experimental results presented in this book will introduce a wide audience to this important area of quantum optics.

Proceedings of SPIE present the original research papers presented at SPIE conferences and other high-quality conferences in the broad-ranging fields of optics and photonics. These books provide prompt access to the latest innovations in research and technology in their respective fields. Proceedings of SPIE are among the most cited references in patent literature.

The Eighth Rochester Conference on Coherence and Quantum Optics was held on the campus of the University of Rochester during the period June 13-16,2001. This volume contains the proceedings of the meeting. The meeting was preceded by an affiliated conference, the International Conference on Quantum Information, with some overlapping sessions on June 13. The proceedings of the affiliated conference will be published separately by the Optical Society of America. A few papers that were presented in common plenary sessions of the two conferences will be published in both proceedings volumes. More than 268 scientists from 28 countries participated in the week long discussions and presentations. This Conference differed from the previous seven in the CQO series in several ways, the most important of which was the absence of Leonard Mandel. Professor Mandel died a few months before the conference. A special memorial symposium in his honor was held at the end of the conference. The presentations from that symposium are included in this proceedings volume. An innovation, that we believe made an important contribution to the conference, was the inclusion of a series of invited lectures chaired by CQO founder Emil Wolf, reviewing the history of the fields of coherence and quantum optics before about 1970. These were given by three prominent participants in the development of the field, C. Cohen-Tannoudji, 1. F. Clauser, and R. I. Glauber.

This anthology is devoted to the theoretical and experimental study of coherent phenomena in quantum optics. Considerable attention is devoted to the

investigation of cooperative effects in multilevel molecular and atomic systems. The theoretical analysis is based on a single approach, using the theory of groups, which makes it possible to present the results in a compact and physically elegant form. The results of a detailed experimental and theoretical investigation of the photon echo, self-induced transparency, and nutation are presented. The theory of a coherent resonant mechanism for the interaction of laser radiation with multi atomic molecules which causes "prompt" dissociation is presented. A number of applied pos sibilities, in particular, the control of radiation by laser light and laser isotope separation, are analyzed.

Advances in Atomic, Molecular, and Optical Physics provides a comprehensive compilation of recent developments in a field that is in a state of rapid growth, as new experimental and theoretical techniques are used on many problems, both old and new. Topics covered include related applied areas, such as atmospheric science, astrophysics, surface physics, and laser physics, with timely articles written by distinguished experts that contain relevant review material and detailed descriptions of important developments in the field. Presents the work of international experts in the field Comprehensive articles compile recent developments in a field that is experiencing rapid growth, with new experimental and theoretical techniques emerging Ideal for users interested in optics, excitons, plasmas, and thermodynamics Topics covered include atmospheric science, astrophysics, surface physics, and laser physics, amongst others

Cooperative Effects in Optics: Superradiance and Phase Transitions presents a systematic treatment of the modern theory of cooperative optical phenomena-processes in which the behavior of many-body systems of radiators or absorbers is essentially determined by their collective interactions with each other. The book focuses on the theory of collective spontaneous radiation (superradiance) and provides a detailed physical explanation of the mechanism of collective spontaneous emission. It considers numerous models of novel nonequilibrium light-induced phase transitions in a typical quantum electronics system, including two-level atoms interacting with the radiation field and more complex systems of three-level atoms, two-bank semiconductors, and other interatomic interactions with the electrostatic and lattice displacement fields. The book uses some of these models for the interpretation of experimentally observed light-induced critical phenomena. Cooperative Effects in Optics is of great value to research workers in the field of cooperative optical phenomena, especially in the determination of the physical essence of theoretical models developed to describe cooperative effects in multi-atomic systems.

The field of nonlinear optics developed gradually with the invention of lasers. After the discovery of second-harmonic generation in quartz, many other interesting nonlinear optical processes were rapidly discovered. Simultaneously theoretical programmes for the understanding of nonlinear optical phenomena were stimulated in accordance to develop structure-property relationships. In the beginning, research advances were made on inorganic ferroelectric materials

followed by semiconductors. In the 1970's, the importance of organic materials was realised because of their nonlinear optical responses, fast optical response, high laser damage thresholds, architectural flexibility, and ease of fabrication. At present materials can be classified into three categories - inorganic ferroelectrics, semiconductors, and organic materials. Advances have also been made in quantum chemistry approaches to investigate nonlinear optical susceptibilities and in the development of novel nonlinear optical devices. Generally, inorganic and organic nonlinear optical materials and their related optical processes are reported in separate meetings. This book collects for the first time papers covering the recent developments and areas of present research in the field of nonlinear optical materials.

This volume presents the written versions of papers that were delivered at the Third Rochester Conference on Coherence and Quantum Optics, held on the campus of the University of Rochester during the three days of June 21-23, 1972. The Conference was a sequel to two earlier meetings devoted to the same field of modern physics, that were also held in Rochester in 1960 and in 1966. The scope of the Conference was largely confined to basic pro blems in the general area of optical coherence and quantum optics, and excluded engineering applications that are well covered by other meetings. Approximately 250 scientists from 9 countries participated, most of whom are active workers in the field. Alto gether 72 papers, including 26 invited papers, were presented in 17 sessions. The papers dealt mainly with the subjects of resonant pulse propagation, lasers, quantum electrodynamics and alternative theories, optical coherence, coherence effects in spontaneous emis sion, light scattering, optical correlation and fluctuation measure ments, coherent light interactions and quantum noise. The program was organized by a committee consisting of N. Bloembergen (Harvard University) J. H. Eberly (University of Rochester) E. L. Hahn (University of California at Berkeley) H. Haken (University of Stuttgart, Germany) M. Lax (City College of New York) B. J. Thompson (University of Rochester) L. Mandel (University of Rochester) }J'oint secretaries E.

This book is devoted to recent developments in quantum mechanics. After an Introductory chapter, Chapter 2 describes the cooperative spontaneous lasing mechanism in gas in three level systems and their possible quantum retardation effects. Chapter 3 is concerned with the evolution of states of large quantum particle systems via marginal correlation operators. Chapter 4 studies the effects of electronic transfer using ab initio quantum calculation methods to access biological macromolecular system behaviors. Chapter 5 concentrates on new features of supersymmetric quantum mechanics using the adjunction of boson-fermion symmetry. The book will be of interest to graduate and Ph.D students as well as scientists from various backgrounds who are concerned with quantum effects.

Principles of Laser Spectroscopy and Quantum Optics is an essential textbook for graduate students studying the interaction of optical fields with atoms. It also

serves as an ideal reference text for researchers working in the fields of laser spectroscopy and quantum optics. The book provides a rigorous introduction to the prototypical problems of radiation fields interacting with two- and three-level atomic systems. It examines the interaction of radiation with both atomic vapors and condensed matter systems, the density matrix and the Bloch vector, and applications involving linear absorption and saturation spectroscopy. Other topics include hole burning, dark states, slow light, and coherent transient spectroscopy, as well as atom optics and atom interferometry. In the second half of the text, the authors consider applications in which the radiation field is quantized. Topics include spontaneous decay, optical pumping, sub-Doppler laser cooling, the Heisenberg equations of motion for atomic and field operators, and light scattering by atoms in both weak and strong external fields. The concluding chapter offers methods for creating entangled and spin-squeezed states of matter. Instructors can create a one-semester course based on this book by combining the introductory chapters with a selection of the more advanced material. A solutions manual is available to teachers. Rigorous introduction to the interaction of optical fields with atoms Applications include linear and nonlinear spectroscopy, dark states, and slow light Extensive chapter on atom optics and atom interferometry Conclusion explores entangled and spin-squeezed states of matter Solutions manual (available only to teachers)

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